REMARKS

Claims 1-28 are presented for examination in this application.

The indication of allowable subject matter in claims 2-7 and 14-21 is noted and appreciated.

The remaining claims have been rejected, primarily over Brown 5,033,655. The Examiner apparently suggests that FIGS. 14-17 of the Brown reference discloses the method of the present invention, including "compression molding" a combined liner and nozzle on a plastic closure. The term "compression molding" is a term of art in the field of plastic product manufacture. Enclosed with this Amendment is a definition of "compression molding" from *A Plastics Primer* by Charles E. Chastain. This document defines "compression molding" as:

> a technique of thermoset molding in which the molding compound (generally preheated) is placed in the open mold cavity, [the] mold is closed, and heat and pressure (in the form of a downward moving ram) are applied until the material is cured.

Any number of similar definitions of "compression molding" can be obtained in other technical treatises, from the internet, etc. Indeed, any number of US patents can be cited relative to use of the term "compression molding" as applied to liners compression molded within closure shells. US Patents 4,984,703, 5,265,747, 5,451,360, 5,650,113, 6,371,318, 6,399,170 and 6,660,349 are just a few of literally scores of US patents that could be cited.

FIGS. 14-17 of the Brown patent show a dispensing valve 101 being squeezed and deformed between a retainer 102 and a ring 100 as the retainer is threaded onto a container neck finish. This is not "compression molding" as that term is used and understood in the art.

In any event, independent claims 1, 13 and 24 have been amended to recite the step of placing a mold charge of molten plastic into the closure. This is considered to make express what previously was at least implied by the recitation of "compression molding" the combined liner and nozzle onto the plastic closure.

Wilde 4,343,754, cited as a secondary reference, discloses compression molding a liner onto the base wall of a closure shell. However, there is no disclosure or suggestion in Wilde of providing the shell with an opening in the base wall, or of compression molding a combined liner and nozzle onto the base wall of the closure shell.

It therefore is believed and respectfully submitted that all claims 1-28 remaining in the application are allowable at this time, and favorable action is respectfully solicited.

Please charge any fees associated with this submission to Account No. 15-0875 (Owens-Illinois).

Respectfully submitted,

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A plastics primer

By Charles E. Chastain*

The term "plastics" is applied to a large and varied group of synthetic materials that are processed by molding or forming them to final shape. Chemically, plastics are composed of chain-like molecules of high molecular weight, called polymers, that usually have been built up from simpler chemicals called monomers. A different monomer or combination of monomers is used to manufacture each different type or family of plastics.

There are about 40 basic plastics families with commercial significance today and each differs from all others. For example, a plastic may be soft (polyurethane foam) or hard (melamine); clear (acrylic) or opaque (phenolic); heat resistant (silicone) or softened by hot water (polyethylene); lighter than water (polypropylene) or heavier than iron (lead filled epoxy). Within each family group there are also wide differences between materials. By changing the molecular weight and chain geometry of a polymer, different properties can be achieved. In addition fillers, plasticizers and other chemicals can be added in various quantities to the basic polymer to further modify its properties.

Each plastic has a particular combination of properties, processing requirements and economics that make it ideally suited for certain applications, yet unsuitable for many others.

Classification

All plastics materials are divided into two classes, thermoplastics and thermosets, according to the way each behaves under repeated conditions of heating and cooling.

A *thermoplastic* requires heat (thermo) to make it formable (plastic) and after cooling can be reheated and reformed into new shapes a number of times without significant change in properties. In this regard a thermoplastic is like a paraffin wax in that each can be repeatedly melted by heat and solidified by cooling. Thermoplastics have linear molecular chains that will flow over each other when heated and solidify into a new shape when cooled without significant chain breakage. Therefore, thermoplastic scrap can usually be reclaimed and reprocessed without difficulty. Polyethylene, polystyrene, PVC, cellulosics, ABS and nylon are some examples of the thermoplastic materials.

A *thermoset* uses heat (thermo) to make its shape permanent (set). After a thermoset is formed into permanent shape, usually with heat and pressure, it cannot be remelted or reformed. Heating a thermoset is somewhat like cooking an egg; once cooked, it is set permanently. Additional heating will only destroy it. Some typical thermosets are phenolics, ureas and melamines.

When heated, thermosets form permanent crosslinks between the linear chains, creating a very rigid three-dimensional chain structure that cannot be made to flow again. Subsequent heating and pressure only cause chain breakage, which results in serious degradation of properties.

A few thermosets do not require outside heat and need little or no pressure to achieve permanent set. Polyester, epoxy, silicone and polyurethane are usually molded from liquid components that can react with certain chemicals at room temperature to create tightly crosslinked chain structures. Once the reaction is completed, a permanent set is achieved and the plastic cannot be reformed or remelted. Using liquid thermosets may be likened to mixing and curing concrete: mixtures of chemicals are required in definite ratios, and the mixture will harden by a chemical reaction in a short time without outside heat or pressure. Thermoset scrap cannot be reprocessed.

Choosing the right plastic

Choosing which plastic to use in a particular application is difficult, considering the 40-plus different families—and sometimes hundreds of individual types within each family—from which to choose. However, the choice becomes progressively easier as one defines his material needs for his specific end-use application with increasing accuracy and completeness.

Some of the differences between plastics that should be considered when defining your needs are degree of stiffness or flexibility; useful temperature range; tensile, flexural and impact strengths; intensity, frequency and duration of loads; electrical strengths; color retention under environment; stress-crack resistance over time; wear and scratch resistance; moisture and chemical resistance at highest temperature; gas permeability; weather and sunlight resistance over time; odor and taste; long-term creep properties under critical loads; production required (quantity, speed, machinery); design limitations due to materials, methods and economics; and material costs/lb./cu. in. and per unit of strength.

A knowledgeable designer will determine his requirements in at least the above areas and assign a relative importance to each. For example, tensile strength could be valued as above 6000 p.s.i. (essential), above 8000 p.s.i. (desirable), above 12,000 p.s.i. (unimportant), etc. until all requirements are so rated. Choosing the best plastic for an application then becomes a matter of finding a *material with all the essential properties plus the greatest number of desirable properties wanted for the product at the lowest final unit cost.*

Quick guide to thermoplastics

ABS (acrylonitrile-butadiene-styrene). Very tough, has unusual combination of high rigidity and impact strength; easiest of all thermoplastics to electroplate; readily accepts decorating or painting; excellent embossing properties and retains embossed pattern after thermoforming; fair chemical resistance; very low moisture absorption; good dimensional stability and high abrasion resistance; formulation of the material can be varied to obtain different combinations of flexibility, heat resistance and toughness.

Acetal. Engineering plastic with very high tensile strength, stiffness and exceptional dimensional stability; high chemical resistance, high abrasion resistance, low moisture absorption, excellent resistance to creep under load; highest resistance to vibration fatigue of any commercial thermoplastic; no known solvent at room temperature and low tendency to stress crack; nontracking electrically and burns soot-free; especially noted for low coefficient of friction and superior retention of physical properties under hot water immersion. Two types of acetal plastics available: *homopolymers,* which have higher strengths and *copolymers,* which are easier to process.

Acrylic. Widely used for high optical clarity and brilliant transparent colors; best of all transparent plastics in resistance to outdoor weathering; excellent electrical strengths; nontracking; hard, glossy surface; fair chemical resistance. The three basic types available are cast sheet (used for glazing and outdoor signs), standard molding powders (used for molding lenses and dials) and high-impact molding powders (less transparent but will take higher shock loads).

Cellulosics. Among toughest of all plastics. Five basic families are nitrate, acetate, propionate, butyrate and ethyl cellulose. Nitrate is the toughest of these but is highly inflammable and explosive; difficult to process except by sheet thermoforming; embrittles with age. Acetate is much easier to process; not explosive; has brilliant transparent colors but poor solvent resistance; embrittles with age. Propionate and butyrate have improved chemical and weather resistance and much less tendency to embrittle with age. Ethyl cellulose has very high shock resistance, even at —40° F., but has poor outdoor weather resistance.

Fluoroplastics. Four general types: TFE, CTFE, FEP and PVF_2. TFE has

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Cellulose ester—A derivative of cellulose in which the free hydroxyl groups attached to the cellulose chain have been replaced wholly or in part by acidic groups, e.g., nitrate or carboxylate groups. Esterification is effected by the use of a mixture of an acid with its anhydride in the presence of a catalyst, such as sulfuric acid. Mixed esters of cellulose, e.g., cellulose acetate butyrate, are prepared by the use of mixed acids and mixed anhydrides. Esters and mixed esters, a wide range of which are known, differ in their compatibility with plasticizers, in molding properties and in physical characteristics. These esters and mixed esters are used in making thermoplastic molding compositions.

Cellulose nitrate (nitrocellulose)—A nitric acid ester of cellulose manufactured by the action of a mixture of sulfuric acid and nitric acid on cellulose, such as purified cotton linters. The type of cellulose nitrate used for celluloid manufacture usually contains from 10.8 to 11.1% of nitrogen. The latter figure is the nitrogen content of the dinitrate.

Cellulose propionate—An ester of cellulose made by the action of propionic acid and its anhydride on purified cellulose. It is used as the basis of a thermoplastic molding material.

Cellulose triacetate—A cellulosic material made by reacting purified cellulose with acetic anhydride in the presence of a catalyst. All three hydroxyl groups in each glucose unit of the cellulose are esterified. It is used in the form of films and fibers. Films and sheets are cast from clear solutions onto "drums" with highly polished surfaces. The film, which is of excellent clarity, has high tensile strength, good heat resistance and dimensional stability.

Center gated mold—An injection mold wherein the cavity is filled with resin through an orifice interconnecting the nozzle and the center of the cavity area. Normally, this orifice is located at the bottom of the cavity when forming items such as containers, tumblers, bowls, etc.

Centipoise—A unit of viscosity conveniently and approximately defined as the viscosity of water at room temperature. The following table of approximate viscosities at room temperature may be useful for rough comparisons:

Liquid	*Viscosity in centipoises*
Water	1
Kerosene	10
Motor oil SAE 10	100
Caster oil; glycerin	1,000
Corn syrup	10,000
Molasses	100,000

Centrifugal casting—A method of forming thermoplastic resins in which the granular resin is placed in a rotatable container, heated to a molten condition by the transfer of heat through the walls of the container and rotated so that the centrifugal force induced will force the molten resin to conform to the configuration of the interior surface of the container. Used to fabricate large diameter pipes and similar cylindrical items.

Chain length—See *Degree of polymerization.*

Charge—The measurement or weight of material used to load a mold at one time or during one cycle.

Chase—An enclosure of any shape used to: (a) shrink-fit parts of a mold cavity in place; (b) prevent spreading or distortion in hobbing; (c) enclose an assembly of two or more parts of a split cavity block.

Chemically foamed plastic—A cellular plastic whose structure is produced by gases generated from the chemical interaction of its constituents, e.g., polyurethanes.

Chill roll—A cored roll, usually temperature controlled with circulating water that cools the web before winding. For chill roll (cast) film, the surface of the roll is highly polished. In extrusion coating either a polished or a matte surface may be used depending on the surface desired on the finished coating.

Chill roll extrusion (or cast film extrusion)—The extruded film is cooled while being drawn around two or more highly polished chill rolls cored for water cooling for exact temperature control.

Chlorinated polyether—A chlorine substituted polymer containing the ether linkage ($-\underset{|}{\overset{|}{C}}-O-\underset{|}{\overset{|}{C}}-$). Pentaerythritol, cyclized to an oxetane by dehydration and then polymerized by opening the ring structure is one example of a polyether.

Choked neck—Narrowed or constricted opening in the neck of a container.

CIL (flow test)—A method of determining the rheology or flow properties of thermoplastic resins developed by Canadian Industries Limited. In this test, the amount of the molten resin which is forced through a specified size orifice per unit time when a specified, variable force is applied gives a relative indication of the flow properties of various resins.

Clamping plate—A plate fitted to a mold and used to fasten the mold to a machine.

Clamping pressure—In injection molding and in transfer molding, the pressure which is applied to the mold to keep it closed in opposition to the fluid pressure of the compressed molding material.

Closed-cell foam—A cellular plastic in which there is a predominance of non-interconnecting cells.

Clearance—A controlled distance by which one part of an object is kept separated from another part.

Coating—See specific type of coating such as *Curtain, Extrusion, Kiss-roll coatings.*

Coat hanger die—One basic type of extrusion slot die shaped internally like a coat hanger to gain better distribution across the full width of a sheet extrusion.

Coating weight—The weight of coating per unit area. In the United States usually "per ream," i.e., 500 sheets 24 x 36 in. (3000 sq. ft.), but sometimes 1000 sq. feet.

Coefficient of expansion—See *Thermal expansion.*

Cold flow—See *Creep.*

Cold molding—A procedure in which a composition is shaped at room temperature and cured by subsequent baking.

Cold slug—The first material to enter an injection mold; so called because in passing through sprue orifice it is cooled below the effective molding temperature.

Cold slug well—Space provided directly opposite the sprue opening in an injection mold to trap the cold slug.

Cold stretch—Pulling operation with little or no heat, usually on extruded filaments, to improve tensile properties.

Collapse—Contraction of the walls of a container, e.g., upon cooling, leading to a permanent indentation.

Compression mold—A mold which is open when the material is introduced and which shapes the material by heat and by the pressure of closing.

Compression molding—A technique of thermoset molding in which the molding compound (generally preheated) is placed in the open mold cavity, mold is closed, and heat and pressure (in the form of a downward moving ram) are applied until the material has cured.

Compression ratio—In an extruder screw the ratio of volume available in the first flight at the hopper to the last flight at the end of the screw.

Compressive strength—Pressure load at failure of a shaped specimen divided by a cross-sectional area of the specimen, usually the original sectional area.

Continued on p. 34